June 9, 1949.

Dr. F. Moewus,
Dept. Botany,
University of Heidelberg,
Germany, U.S. Zone.

Dear Dr. Moewus:

I enclose reprints of a review article and of some of my experimental work which may be of interest to you. If I may apologize for the hasty treatment which was given to the genetics of the algae, it would be partly based on the difficulty of obtaining here a comprehensive and definitive set of your publications.

I would appreciate it greatly, therefore, if you could send me such of your works as are available still, and would place my name on your mailing list, a favor which I shall be gladito reciprocate.

Yours sincerely,

Joshua Lederberg,
Assistant Professor of Genetics.

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celia from zygospores heterozygous for three factors. No gospore yielded more than four mutually complementary sporangiospores, although all of the eight possible classes vered from several zygospores together. In dihybrid crosses, approximately equal numbers of *tetratype* and *ditype* zygospores. nded that, contrary to his own cytological findings, only a ote contributes to the germ mycelium.

pores of *Mucor mucedo* were subjected to a similar analysis by 1935), who concluded that only a single reduced nucleus ince no genetic diversity was found among the issue of a ospore.

c non-disjunction of sex-incompatibility factors has been by Burgeff (1915). While he could account for this in some pore cultures by heterokaryosis for incompatibility factors, some mycelia from which he was unable to segregate out the components except from the zygospores they produced. uded, therefore, that these mycelia contained unreduced uclei heterozygous for the sex alleles. If these mycelia are oid, they provide excellent material for the comparison eractions within and across nuclear membranes.

a *grandis* shows another sort of anomalous behaviour 942*b*). The species is homothallic and produces superficially gospores in pure culture. However, no cytological evidence ound either of nuclear fusion or of meiosis.

ility of genetic analysis in the solution of life-cycle problems lustrated by Emerson's work on *Allomyces* (1941). The *sculus* and *javanicus* differ primarily in the arrangement metangia. Although homothallic, the organisms can be the separation of male and female gametangia. By g when segregation of the differential characters occurred, f reduction-divisions could be placed. It was shown that n alteration of diploid and haploid thalli " a most unusual ffairs; extensively developed thalli with true, actively iploid nuclei are probably not ordinarily formed by any *ycetes*."

ver fungi exhibit a wide range of nuclear and life-cycle the potentialities of which have scarcely begun to be Aside from the studies already alluded to on the Mucorales *myces*, and incidental observations on some Myxothallophyta 1935), there has been no consideration of these forms as genetic study, although it is almost certain that it would ations of fundamental importance.

(ii) Algae

work on algæ has been overshadowed by the numerous ons of F. Moewus (*cf.* Buzzati-Traverso, 1947, p. 38) on the onads. Unfortunately, this " most remarkable series of studies in biochemical genetics . . ." (Beadle, 1945*a*) has been challenged in almost every detail (Smith, 1946 ; Sonneborn, 1941 ; Lwoff, 1947). To these comprehensive analyses, the present writer can add no informed comment. However, earlier work on algæ should not be overlooked, and Hartmann's review (1929) will be useful in planning experiments on this group.

Genetic recombination in bacteria and viruses will be dealt with separately because of the unique argument that must be used for its demonstration.

MODES OF GENETIC VARIATION

(*i*) *The Particulate Basis*

Genetic investigations of "perfect fungi" have clearly shown Mendelian corpuscular behaviour of genetic determinants ; but there have been many attempts to formulate alternative systems for organisms, such as bacteria, less amenable to recombination analysis. Huxley wrote, speculatively, of bacteria that "the entire organism appears to function both as soma and germ plasm and evolution must be a matter of alteration in the reaction system as a whole" (1942). Similarly, Darlington (1939) refers to "genes which are still undifferentiated in viruses and bacteria." However, these statements are now probably convenient targets for controversy rather than expressions of their authors' present opinions.

The lack of outward differentiation of bacteria and viruses does give the appearance of holo-cellular propagation, and of an identity between direct transmission and inheritance. In binary fission, the substance of the cell is of course transmitted intact to the offspring. Inherited characters are fashioned out of this material. Rather than postulate an autonomous regulatory mechanism, therefore, many students have formulated the genetic system as the direct transmission of the material characters. Hinshelwood (1946), for example, has defined the bacterial cell as an extended fabric of enzymes with both auto- and hetero-catalytic properties. However, his admission that radiation induced mutations affecting enzymatic activity imply definite localisation of autocatalytic functions is difficult to distinguish from the abandonment of his definition.

The direct transmission theory may be disproved in several ways. First, bacteria are not so undifferentiated after all. In *Salmonella*, for example, they carry on their surfaces flagella containing serologically distinctive substances. When grown on agar containing phenol, they lose both flagella and specific antigens. A passage through ordinary medium suffices to restore these differentiated structures in their original form. The determinants of flagellar specificity are therefore transmitted in the absence of the flagella. The contrary result of a similar experiment, the inordinate delay in the restitution of antigens removed from the surface of *Paramecium aurelia* by antiserum